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NOTES ON VEGETATION AND FLORA OF AGUMBE

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INTRODUCTION

Agumbe—Hulical ranges in Shimoga district, Karnataka form a part of the narrow evergreen strip of Western Ghats, except for Kadambi's work (1941, 1942) there is no comprehensive account on the flora of this region. Kadambi (1960) has enumerated 236 species from the entire evergreen forests of Mysore State but the list hardly covers 20% of the species. Hence, explorations were undertaken to obtain detailed knowledge of the angiosperm flora of the region.

TOPOGRAPHY, GEOLOGY AND CLIMATOLOGY

The area explored falls within 13°27′ to 13°45′ N and 75°0′ to 17°17′ E., covering nearly 80,000 hectares of Shimoga district, embracing most of Tirthahalli and part of Hosnagar taluks. The underlying rock whose altitude hardly exceeds 800 m above sea level which is generally gneiss and hornblende schist covers as far as Nishanigudda, extending as a narrow belt along the crest of the ghat. The surface rock is invariably a bed of laterite. Minerals commonly seen are felspar, biotite, hornblende, black, mica and garnet. Manganese and iron ores are abundant at Nishanigudda and Tirthahalli. Soil is generally as a result of decomposed gneiss below and consists of ferrugineous sandy loam.

Maximum rainfall is due to south-west monsoon though north-east monsoon also brings a little rain. Agumbe is called the second Cherrapunji of India as the crest of the ghat at Agumbe and Hulical receives rainfall ranging from 6300-13000 mm (mean 8500 mm). There is an abrupt decrease towards the interior. Both Tirthahalli and Hosnagar situated hardly 30 km away from Agumbe & Hulical, respectively receive only 2400 mm —4750 mm (mean 3300 mm) of rainfall. The total number of rainy days varies from 119-159 (mean 134 days) for Agumbe & Hulical and 90-128 (mean 107 days) for Tirthahalli. The hottest months are March-April (33°-35° C) and the coldest months are December-January (10-5°-14.8° C). High velocity winds blow especially during the monsoon months.

VEGETATION

The vegetation can broadly be classified into (a) Tropical evergreen and (b) moist deciduous forests through transition stages of semi-evergreen types. In the evergreen zone occur grassy hill tops practically bereft of shrubs or trees. Whereas the transition from the evergreen to the grassy hill tops is sudden and abrupt, the transition from the evergreen to the deciduous is, often almost imperceptable. With decreasing rainfall and altitude, the vegetation gradually changes into the moist deciduous forests as one proceeds from Agumbe and Hulical towards Tirthahalli or Hosnagar. The aquatic, marshy or weed flora in the cultivated fields is more or less uniform throughout.

Tropical Rain Forests or the Evergreen Ghat Forests

The evergreen belt which Kadambi (1941)

calls as "evergreen ghat forests" extends all along the ghat region facing South Kanara. The altitudinal and horizontal distribution of the forests vary depending on elevation and aspect which are briefly dealt with below :

A. Altitudinal distribution of the forests :

Three distinct zones are recognised which are as follows :

a) Forest from the foot of the ghat (100 m) to crest (400 m).

The vegetation is conspicuous in the absence of such prominent evergreen species as *Calophyllum elatum* Bedd., *Dipterocarpus indicus* Bedd., *Mesua nagassarium* (Burm.) Kosterm., *Mastixia arborea* (Wight) Bedd. and *Poeciloneuron indicum* Bedd., which are so common at Agumbe. *Acrocarpus fraxinifolius* Wight, *Aglaia talbotii* Sundaraghavan, *Alstonia scholaris* (L.) R. Br., *Artocarpus gomezianus* Wall. ex Tree. subsp. *Zeylanicus* Jarrett, *Beilschmeidia gemmiflora* (Bl.) Kosterm., *Homalium zeylanicum* (Gard.) Benth., *Myristica dactyloides* Gaertn., *Pterospermum diversifolium* Bl., *Polyalthia fragrans* (Dalz.) Bedd., *Psychotria octosulcata* Talb. etc., which are either absent or poorly represented at Agumbe are commonly found here. With decreasing elevation, deciduous species such as *Adina cordifolia* (Roxb.) Hook. f. ex Brandis, *Terminalia chebula* (Gaertn.) Retz., *T. bellirica* (Gaertn.) Roxb., and species of *Dalbergia, Grewia* and *Lagerstroemia* become common. At the foot of the ghat occur *Garcinia indica* Chois., *Strychnos nux-vomica* L. and *Xanthophyllum flavescens* Roxb. which are absent above. Species of *Calamus* which form impenetrable breaks higher up are displaced by bamboo lower down.

(b) Ghat crest region from 400 m to 750 m.

Here occur the climax type of evergreen forests. *Ailanthus triphysa* (Dennst.) Alston, *Calophyllum apetalum* Willd., *Canarium strictum* Roxb., *Cryptocarya bourdillonii* Gamble *Diospyros sylvatica* Roxb., *Lophopetalum wightianum* Arn., *Dipterocarpus indicus* Bedd., *Dyoxylum malabaricum* Bedd., *Elaeocarpus tuberculatus* Roxb., *Garcinia talbotii* Raiz. & Sant., *Holigarna* spp. *Mesua nagassarium* (Burm.) Kosterm., *Persea macrantha* (Nees) Kosterm., *Poeciloneuron indicum* Bedd. etc. all flourish. The undergrowth is chiefly composed of *Agyaia anamallayana* (Bedd.) Kosterm., *Chasalia ophioxyloides* (Wall.) Craib, *Dichapetalum gelonioides* (Roxb.) Engler, *Diospyros nigrescens* (Dalz.) Saldanha, *Euonymus indicus* Heyne, *Gomphandra tetrandra* (Wall.) Sleumer, *Humboldtia brunonis* Wall., *Lasianthus acuminatus* Wight and species of *Casearia, Ixora, Psychotria, Salacia* etc.

(c) Sparsely clad grassy hill tops (750 m to 900 m).

Along the slopes occur stunted or crooked trees of *Careya arborea* Roxb., *Dillenia pentagyna* Roxb., *Glochidion velutinum* Wight, *Linociera malabarica* Don, *Syzygium caryophyllatum* (L.) Alston, *Phoenix humilis* Royle, *Wendlandia thyrsoidea* (R. & S.) Steudel, *Xeromphis spinosa* (Thunb.) Keay etc., that at any rate do not exceed *ca* 8 m in height. The bracken *Pteridium aquilinum* (L.) Kuhn., along with species of *Nilgirianthus* and *Themeda* forms gregarious patches. Along moist shady rocks occur *Atalantia wightii* Tan., *Coleus malabaricus* Benth., *Murraya paniculata* (L.) Jack, *Naregamia alata* Wight & Arn., *Scutellaria discolor* Coleb., and *Solanum aculeatissimum* Jacq. In crevices of rocks are seen *Ariopsis peltata* Nimmo, *Argostemma courtallense* Arn., *Neurocalyx wightii* Arn., *Torenia thouarsii* Ktze. and *Sonerila* sp.

On grassy hill tops *Cyanotis arachnoides* C. B. Cl. var. *thwaitesii* (Hassk.) Rolla Rao et Kammathy, *Iphigenia sahyadrica* Ansari et Rolla Rao, *Juncus prismatocarpus* R. Br., *Murdannia semiteres* (Dalz.) Sant., *Tylophora fasciculata* Wight as well as species of *Centratherum, Canscora, Chlorophytum, Exacum, Habenaria, Senecio, Trichodesma* etc., occur scattered amidst the grasses. At Nishanigudda due to the combined influence of unfavourable conditions of soil and the desiccating effect of wind, there is hardly any vegetation. There does not appear to have been any forest here even in the past.

B. *Horizontal distribution of the forests* :

A narrow belt of *Poeciloneuron-Mesua* community along with *Aglaia barberi* Gamb., *Meiogyne pannosa* (Dalz.) Sinclair and species of *Psychotria,* occurs along the ghat crest region. Closely follows the *Poeciloneuron-Dipterocarpus* community extending 3-4 km towards the interior with *Dipterocarpus* towering over *Poeciloneuron.* Here, besides the above two tall species, *Mangifera indica* L. *Diospyros sylvatica* Roxb., *Palaquium ellipticum* Engl., *Elaeocarpus tuberculatus* Roxb. and *Strombosia ceylanica* Gard., also attain great heights, with prominent buttresses. *Humboldtia brunonis* Wall., is a common undergrowth, 5-8 km away is the *Hopea* community, with *H. parviflora* Bedd., dominant along with *Cassine glauca* (Rottb.) Ktze., *Canarium strictum* Roxb., species of *Diospyros* and *Ficus.* In disturbed forest areas the *Lagerstroemia community* is conspicuous, with a sprinkling of species belonging to *Careya, Dillenia, Mallotus, Ligustrum, Terminalia, Xeromphis* etc. An edaphic variant of the rain forests is the *Myristica community* in swampy areas characterised by knee roots.

Amidst the closely packed mass of dense foliage it is possible to distinguish the various forests tiers. The first storey is composed of *Calophyllum elatum* Bedd., *Dipterocarpus indicus* Bedd., *Elaeocarpus tuberculatus* Roxb., *Mesua nagassarium* (Burm.) Kosterm., *Mangifera indica* L. and *Vateria indica* L., towering over 40 m with a girth of 3.5 m or more. The second tier mostly consists of *Artocarpus hirsuta* Lamk., *Canarium strictum* Roxb., *Chrysophyllum roxburghii* G. Don, *Diospyros sylvatica* Roxb., *Dysoxylum malabaricum* Bedd., *Holigarna grahamii* (Wight) Kurz., *Hopea parviflora* Bedd, *Lophopetalum wightianum* Arn., *Lagerstroemia microcarpa* Wight, *Mastixia arborea* (Wight) Bedd., *Myristica dactyloides* Gaertn., *Palaquium ellipticum* Engler, *Persea macrantha* (Nees) Kosterm., *Poeciloneuron indicum* Bedd., *Turpinia malabarica* Gamble, *Vitex altissima* L. f. and *Veprts bilocularis* (Wight) & Arn. Engler. The third tier consists of moderately tall trees which by their numerical density form the bulk of the forests. These include *Apodytes dimidiata* Arn., *Artocarpus heterophyllus* Lam., *Canthium dicoccum* (Gaertn.) T. & B., *Carallia brachiata* (Lour.) Merr., *Chrysophyllum roxburghii* Don, *Cassine glauca* (Rottb.) Ktze, *Cinnamomum macrocarpum* Hook., *Elaeocarpus serratus* L., *Dimocarpus longan* Lour., *Gordonia obtusa* Wight & Arn., *Garcinia morella* (Gaertn.) Desr., *G. cambogia* (Gaertn.) Desr., *Harpullia arborea* (Blan.) Radlk., *Hopea wightiana* Wight & Arn., *Litsea floribunda* (Bl.) Gamble, *Schleichera oleosa* (Lour.) Oken., *Knema attenuata* (Hook. f. Thom.) Warb, *Symplocos racemosa* Roxb., *S. cochinchinensis* (Lour.) Moore etc., besides species of *Aglaia, Ficus, Glochidion, Litsea, Mallotus, Syzygium* etc.

The undergrowth, composed of trees 8-10 m tall such as *Antidesma menasu* Tul., *Aglaia anamallayana* (Bedd.) Kosterm., *Acronychia pedunculata* (L.) Miq., *Diospyros nigrescens* (Dalz.) Sald., *Euonymus indicus* Wall., *Goniothalamus cardiopetalus* Hook. & Thoms. *Humboltia brunonis* Wall., *Ixora arborea* J. E. Sm., *I. brachiata* Roxb., *Linociera malabarica* Don., *Olea dioica* Roxb., *Memecylon umbellatum* Burm., *Saraca asoca* (Roxb.) de Wilde etc., form the fourth tier. The fifth tier is represented by shrubs. Inside the evergreen forests they are composed of *Agrostistachys indica* Dalz., *Antidesma diandra* Roth, *Chasalia ophioxyloides* (Wall.) Craib, *Lasianthus acuminatus* Wight, *Mackenziea integrifolia* (Dalz.) Bremek., species of *Nilgirianthus, Psychotria dalzellii* Hook., *P. nigra* (Gaertn.) Alston, *P. truncata* Wall.

Thelepaepale ixiocephala Bremek. etc., mostly representing *Acanthaceae, Euphorbiaceae* and *Rubiaceae.* Along the forest edges occur *Barleria courtallica* Nees, *B. involucrata* Nees, *Callicarpa tomentosa* (L.) Murr., *Clerodendrum viscosum* Vent., *C. serratum* (L.) Moon., *Dichapetalum gelonioides* (Roxb.) Engler, *Dracaena terniflora* Roxb., *Glycosmis mauritiana* (Lamk.) Tanaka, *Gomphandra tetrundra* (Wall.) Sieumer, *Leea crispa* L., *Microtropis stocksii* Gambl., *Premna coriacea* C. B. Cl. and *Zanthoxylum ovalifolium* Wight. Along valleys are seen *Agrostistachys indica* Dalz., *Debregeasia longifolia* (Burm.) Wedd., *Dendrocnide sinuata, Dimorphocalyx lawianus* Hook. f., *Lepianthes umbellata* (L.) Raf., *Pellionia heyneana* Gaud. *Vernonia ornata* Talb. and *Nilgirianthus* spp. In cleared forests occur *Glochidion velutinum* Wight, *Maesa indica* (Roxb.) DC., *Mezoneyron cuccullatum* (Roxb.) Wight & Arn. as well as species of *Argyreia, Breynia, Casearia, Salacia, Vitex* etc.

The forests abound lianas and climbers such as *Butea parviflora* Roxb., *B. purpurea Entada pursaetha* DC., *Gnetum ula* Brong., and *Uvaria hookeri* King climbing over 20 m. Conspicuous amongst, the climbers are *Ancistrocladus heyneanus* Grah., *Artabotrys zeylanicus* Hook. & Thom., *Desmos lawii* (Hook. & Thom.) Saff., *Ellertonia rheedii* Wight, *Erycibe paniculata* (Roxb.), *Erythropalum populifolium* (Arn.) Mast., *Gardneria ovata* Wall., *Hugonia belli* Sedg., *Lucunga sarmentosa* (Bl.) Kurz, *Miquelia dentata* Bedd., *Phanera phoenicea* (Wight & Arn.) Benth., *Sarcostigma kleinii* Wight & Arn., *Strychnos colubrina* L., *Trichosanthes bracteata* (Ham.) Voigt and *Thunbergia mysorensis* (Wight) Anders. Along forest clearings occur scandent shrubs such as *Anodendron paniculatum* A. DC., *Aspidopterys canarensis* Dalz., *Capparis cleghornii* Dunn., *Chilocarpus malabaricus* Bedd., *Mezoneuron cucullatum* (Dalz.) Wight & Arn., *Rourea minor* (Gaertn.) Alston and *Wagatea spicata* Dalz.

Herbaceous vegetation varies considerably from luxuriant growth in the valleys or along streams to almost complete absence in the humus laden soil where hardly a few annuals are seen. Myriads of evergreen seedlings are littered along the forest floor through natural regeneration. Members of Zingiberaceae (*Alpinia, Costus, Elettaria, Curcuma, Zingiber* and *Boesenbergia*) are common in the denser portion of the forests and saprophytic orchids as *Zeuxine* and *Epipogium* thrive in decomposing humus where little or no light penetrates. Where there is a break in the forests, *Ellettaria cardamomum* (L.) Maton and species of "*Strobilanthes complex*" extensively occupy the forest floor along with seedlings of *Murraya koenigii* Spr. and *Clerodendrum* sp. The tuberous or bulbous annuals are few and limited. Along forest paths flourish *Adenostemma lavenia* (L.) Ktze., *Centella asiatica* (L.) Urb., *Dichrocephula integrifolia* (L. f.) Ktze., *Dracaena terniflora* (Roxb.) *Geophila reniformis* D. Don, *Hydrocotyl javanica* Thunb. and species of *Justicia, Haplanthus, Pogostemon, Plectranthus, Torenia* and *Ophiorrhiza.*

Root parasites are infrequent, limited to *Aeginetia indica* L., *A. pedunculata* Wall. and such other members of Scrophulariaceae as *Buchnera hispida* Don, *Centranthera indica* (L.) Gamble, *Rhamphicarpa longiflora* Benth., *Sopubia delphinifolia* (L.) Don, species of *Striga* etc. Of the stem parasites Loranthaceae is richly represented by a wide range of genera such as *Viscum, Macrosolen, Helicanthes, Helixanthera, Taxillus, Scurrula, Dendropthoe* and *Tolypanthus.* Trees of *Antidesma menasu* Tul. and *Myristica dactyloides* Gaertn., are occasionally covered by the parasitic *Cassytha filiformis* L. Terrestrial orchids are few, confined to such genera as *Habenaria, Peristylus, Epipogium, Eulophia, Nervilia* and *Zeuzine.*

Moist Deciduous Forests

With a decrease in elevation and rainfall, the transition from evergreen to sub-deciduous and further to mixed deciduous is imperceptibly gradual. Amongst the trees to mention a few are *Hopea wightiana* Wight & Arn. and species of *Dalbergia, Grewia, Lagerstroemia, Sapium, Sterculia, Terminalia, Toona* and *Xantolis*. At Tirthahalli, the transition to moist deciduous forests is complete. Palms and canes are displayed by bamboo. The tree fern is conspicuously absent. Here, *Lagerstroemia microcarpa* Wight is prominent amongst the top storey of trees, along with *Tectona grandis* L. f. Trees in the upper storey include *Alstonia scholaris* (L.) R. Br., *Anthocephalus chinensis, Cassine glauca* (Rottb.) Ktze, *Dalbergia lanceolaria* L. f., *D. latifolia* Roxb., *Heterophragma quadriloculare* K. Schum., *Holoptelea integrifolia* (Roxb.) Planch., *Hymenodictyon excelsum* Wall., *H. obovatum* Wall., *Pajanelia longifolia* (Willd.) Schum, *Schleichera oleosa* (Lour.) Oken, *Stereospermum personatum* (Hassk.) Chatt., *Terminalia crenulata* Roth, *Toona ciliata* Roemer, *Vitex altissima* L. f.,*Xylia xylocarpa* (Roxb.) Taub., etc. The second storey of trees comprises *Bauhinia racemosa* Lam., *Cassia fistula* L., *Eriolaena quinquelocularis* Wight, *Ficus hispida* L. f., *Garcinia xanthochymus* Ander., *Grewia flavescens* A. Juss, *G. tiliifolia* Vahl, *Gloechidion hohenackerii* Bedd., *Lannea coromandelica* (Houtt.) Merr., *Morinda tomentosa* Roth., species of *Sterculia, Madhuca, Wrightia tinctoria* R. Br. etc. The third tier includes *Canthium parviflorum* Lam., *Diospyros montana* Roxb., *Garuga pinnata* Roxb., *Lannea coromandelica* (Houtt.) Merr., *Osyris quadripartita* decaisne, *Santalum album* L., *Sapium insigne* Benth., *Xeromphis uliginosa* (Retz.) Mahes., *Zizyphus oenoplia* Mill. and species of *Albizia, Acacia, Bridelia* and *Flacourtia*.

The shrubby undergrowth is chiefly of *Carissa congesta* Wight *Clerodendrum serratum* (L.) Moon, *Colebrookea oppositifolia* Sm., *Maytenus rothiana, Holarrhena antidysenterica* (Roth) DC., *Flemingia strobilifera* (L.) Aiton, *Blachia denudata* Benth., *Plecospermum spinosum* (Willd.) Trecul., *Gardenia gummifera* L. f., *Rauvolfia densiflora* Benth. and species of *Croton, Jatropha, Argyreia, Pavetta* and *Ixora*.

In areas closely bordering the evergreen forests occur woody scandent shrubs like *Ancistrocladus heyneanus* Grah., *Capparis rheedii* DC., *Connarus wightii* Hook., *Combretum ovalifolium* Roxb., *Diploclisia glaucescens* (Bl.) Diels, *Grewia heteroticha* Mast., *Gardneria ovata* Wall., *Luvunga sarmentosa* (Bl.) Kurz, *Randia rugulosa* (Thw.) Hook., *Rourea santaloides* Wight & Arn., *Premna coriacea* C. B. Cl., *Sarcostigma kleinii* Wight & Arn. and *Ziziphus rugosa* Lam. In cleared forest areas, climbers such as *Capparis zeylanica* L., *Clematis gouriana* Roxb., *Gymnema sylvestre* (Retz.) Schultz, *Hemidesmus indicus* (L.) R. Br., *Naravelia zeylanica* (L.) DC., *Paracalyx scariosa* (Roxb.) Ali, *Passiflora foetida* L., *Rubia cordifolia* L., *Tragia hispida* Willd., *Wattakaka volubilis* (L. f.) Stapf, species of *Asparagus, Dioscorea, Thunbergia* etc., are commonly associated with members of Fabaceae, Vitaceae, Cucurbitaceae and Menispermaceae. Along streams, *Anodendron paniculatum* A. DC., *Chilocarpus malabaricus* Bedd., *Ellertonia rheedii* Wight, *Hiptage benghalensis* (L.) Kurz, and *Solanum seaforthianum* Andr. are frequent.

Unlike in the evergreen forests, the ground vegetation is rich and varied with a distinct seasonal aspect. With the advent of the monsoon, tuberous or bulbous plants of the families Hypoxidaceae, Liliaceae, Amaryllidaceae, Asclepiadaceae, Orchidaceae and Dioscoreaceae make the first appearance. Along the moist rocky slopes, species of *Asystasia, Begonia, Canscora, Centratherum, Cyanotis, Drosera, Exacum, Habenaria, Impatiens, Justicia, Linum, Lindernia, Murdannia, Neanotis, Scilla, Senecio, Spilanthes* and *Utricularia* lend a variety of colours. Many members of Liliaceae, Zingiberaceae and Orchidaceae, as well as Ceropegia complete their flowering within a short period and are apt to be missed, if collections are not made at the appropriate time.

When the rains are well set, *Lobelia nicotianaefolia* R. & S., *Adelocaryum coelestinum* (Lindl.) Brand., *Heracleum rigens* Wall. ex DC., *Pimpinella heyneana* (DC.) Kurz, species of *Commelina, Cyanotis, Dictyospermum* and *Murdannia* as well as species of *Impatiens, Blumea, Senecio, Torenia, Pogostemon, Plectranthus, Haplanthus* etc., are seen profusely flowering. The mid and postmonsoon months are periods of peak flowering in these forests. In the grassy meadows *Canscora decussata* Sch. & Sch., *C. decurrens* Dalz., *Exacum bicolor* Roxb., *Cyathocline lutea* Law, *Burmannia coelestis* Sou, *Oldenlandia caerulea* (Wight & Arn.) Gamble, *O. herbacea* (L.) Roxb., *Sopubia delphiniifolia* (L.) Don, *Rhamphicarpa longifolia* Benth., *Leucas marrubioides* Desf., species of *Desmodium, Smithia* and *Alysicarpus, Launea acaulis* (Roxb.) Babc. ex Kerr, *Murdannia simplex* (Vahl) Brenan, *M. dimorpha* (Dalz.) Bruckn., *Emilia sonchifolia* (L.) DC., *Gnaphalium luteo-album* L. and *Vigna vexillata* (L.) Rich. as well as species of *Impatiens* are common. By mid winter most of the annuals complete their life cycle. Besides, the sedges and grasses, hardly a few members of Asteraceae (*Blumea, Conyza, Gynura, Senecio, Sphaeranthus* and *Crassocephalum*) Acanthaceae (*Blepharis, Justicia, Rungia, Haplanthus, Lepidagathis*) Rubiaceae (*Borreria, Oldenlandia, Ophiorrhiza*), Boraginaceae (*Trichodesma, Cynoglossum*), Lamiaceae (*Ocimum, Orthosiphon, Leucas*) etc., that can survive the drought, are seen. Even these dry up during the summer. In the fallow cultivated fields or near banks of streams with some moisture, are seen patches of *Coldenia procumbens* L., *Drosera burmannii* Vahl, *Dysophilla tomentosa* Dalz., *Polycarpon prostratum* (Forsk.) A. & S., *Polygonum plebeium* R. Br., *Rotala densiflora* (Roth) Koehne, *Salomonia ciliata* DC., *Scoparia dulcis* L., *Sesamum laciniatum* Klein and *Xyris pauciflora* Willd., associated with members of Eriocaulaceae, Cyperaceae and Poaceae.

Epiphytic orchids are scarce, confined to genera such as *Aerides, Dendrobium, Rhynchostylis* and *Pholidota*. During February-March, *Aerides crispum* Lindl., *Rhynchostylis retusa* Bl., *Dendrobium barbatulum* Lindl. and *D. nutans* Lindl., bloom. The dull green flowers of *Nervilia crispala* (Bl.) Schltr., partly covered by the debris of fallen leaves are seen at the fag end of summer. Both *Habenaria crinifera* Lindl. and *H. rariflora* A. Rich., are commonly seen in crevices of barks. During the postmonsoon, the showy terrestrial orchids include *Habenaria heyneana* Lindl., *H. grandifloriformis* Blatt & McCann, *H. marginata* Coleb., *H. rariflora* A. Rich., *H. plantaginea* Lindl., *H. longicorniculata* Grah. and species of *Peristylus*.

Towards Shimoga, the vegetation turns to scrub with *Cassia absus* L., *C. auriculata* L., *Cassia congesta* Wight, *Azima tetracantha* Lam., *Cocculus hirsutus* Diels, *Cissampelos pariera* L., *Capparis sepiaria* L., *Plecospermum spinosum* (Willd.) Trec. etc. being dominant.

Aquatic and Semi-Aquatic Flora

The aquatic or semi-aquatic flora forming a minor element of the total flora of the region is independent of the macroclimate and with little diversity. The submerged aquatics include *Vallisneria spiralis* L., *Blyxa echinosperma* (C. B. Cl.) Hook., *B. octandra* (Roxb.) Thw. and *Hydrilla verticillata* (L. f.) Royle *Najas minor* All., occurs but is rare. The free floating aquatics include *Pistia stratiotes* L., *Spirodela polyrhiza* (L.) Schleiden, *Ludwigia adscendens* (L.) Hara, *Ipomoea aquatica* Forssk. and *Azolla pinnata* R. Br. which are common at Tirthahalli only. However, a majority of the plants belong to the partially submerged, attached, floating aquatics. In the ponds at Tirthahalli, *Limnophyton obtusifolium* (L.) Miq., *Caldesia parnassifolia* (L.) Parl., *Aponogeton natans* Engl. & Kr., *Monochoria vagi-

nalis (Burm.) Presl. and *Nymphoides cristatum* (Roxb.) Kuntze grow gregariously along with such amphibious plants as *Floscopa scandens* Lour., *Polygonum glabrum* Willd, and *P. barbatum* L. Throughout the district, *Limnophila indica* (L.) Druce, *Nymphoides indica* (L.) Kuntze, *Nyphaea pubescens* Willd., *N. nouchali* Burm., *Nelumbo nucifera* Gaertn etc., occupy a considerable area long with *Cyperus platystylis* R. Br., *Hypolytrum nemorum* (Vahl) Spreng., *Schoenoplectus mucronatus* (L.) Palla, *S. juncoides* (Roxb.) Palla, *Sacciolepis interrupta* (Willd.) Stapf., *S. indica* (L.) A. Chase etc.

Rheophytes form an interesting ecosystem by themselves and are well represented. Along the banks of streams dense thickets of *Ochlandra* and *Pandanus* are common, growing, in close association with *Homonia riparia* Lour., *Lygodium flexuosum* (L.) Sw. and *L. scandens* (L.) Sw. Trees such as *Hydnocarpus laurifolia* (Dennst.) Sleumer, *Ficus beddomei* King, *Mastixia arborea* (Wight) Bedd., *Poeciloneuron indicum* Bedd., *Barringtonia racemosa* Roxb., *Madhuca neriifolia* (Moon) Lam., *Cinnamomum macrocarpum* Hook. and *Diospyros malabarica* (Desr.) Kostel., occur along the banks of streams associated with *Phyllanthus talbotii* Sedgw. *P. lawii* Grah., *Ardisia solanacea* Roxb. and species of Polygonum. At higher levels are seen *Carallia brachiata* (Lour.) Merr., *Helicia nilagirica* Bedd. and *Mastixia arborea* (Wight.) Bedd., while at lower altitude occur species of *Cinnamomum, Madhuca* and *Hydnocarpus*. Both *Homonia retusa* M. Arg. and *Rotula aquatica* Lour., are common along the banks of Tunga river growing in association with *Crinum defixum* Ker.-Gawl. and *Cyanotis adscendens* Dalz. In the fast moving streams near Varahi and Vanakeabbi falls, members of Podostemaceae like *Dicraea stylosa* Wight, *Terniola zeylanica* Tuls. and *Griffithella hookeriana* Warm., are fairly frequent. Along the banks of forest streams occur *Boesenbergia pulcherrima* (Wall.) Kuntze *Cryptocoryne retrospiralis* (Roxb.) Kunth, *Hygrophilla pinnatifolia, Lagenandra meeboldii* (Engl.) Fischer, *L. ovata* (L.) Thw., *Hypolytrum nemorum* (Vahl) Spreng., *Hydrocotyl javanica* Thunb., *Adenostemma lavenia* (L.) Kuntze and *Dichrocephala integrifolia* (L. f.) Kuntze.

During the exploration, 1249 species (excluding cultigens) have been collected of which the angiosperms are represented by 1173 species and cryptogams by 75 species. The collections are deposited in the Botanical Survey of India, Western Circle Herbarium, Pune (BSI).

Of the new species described from this region, *Tarenna agumbensis* (Rubiaceae), *Iphigenia sahyadrica* (Liliaceae) and *Isachne mysorensis* (Poaceae) are at present known only from the type localities. Two other species described from and confined to Karnataka viz. *Torenia lindernioides* Sald. and *Marsdenia raziana* Yogan. & Suba. also occur at Agumbe. Both *Torenia indica* and *Chlorophytum bharuchae* known from Western India have been also collected but they are infrequent. A few species, hitherto regarded as restricted or endemic have been collected, extending their distribution.

Borreria verticillata (L.) G. F. W. Meyer (Rubiaceae), *Boesenbergia pulcherrima* (Wall.) O. Kuntze (Zingiberaceae) and *Isachne kunthiana* (Wight & Arn. ex Steud.) Miq. var. *elatior* (Hook. f.) Alston (Poaceae), are found to be new records for India. Both *Borreria verticillata* (a weed of Trop. America & Africa) and *Boesenbergia pulcherrima* are now quite frequent in Chikmagalur, Hassan and South Kanara districts as well, while *Isachne kunthiana* var. *elatior* has been now collected though recorded earlier only from Ceylon.

Oberonia bicornis Lindl. (Orchidaceae) and *Scleria africana* Benth. (Cyperaceae) are new records for peninsular India only.

Clematis triloba Heyne ex Roth (Ranunculaceae), *Smithia purpurea* Hook. (Fabaceae), *Begonia concanensis* A. D. (Begoniaceae) *Cyathocline lutea* Law. ex Wight, *Nanothamnus sericea* Thoms., *Senecio grahamii* Hook. f. (Asteraceae) and *Garnotia arborum* Stapf ex Cooke, *Paspalum compactum* Roth var. *fimbriatum* Bor (Poaceae).

All these species (except *Clematis triloba* and *Senecio grahamii* which have also been recorded from Gujarat) which were regarded as confined to Maharashtra only, have now been collected from Shimoga district also. Similarly the following 5 species, *Diospyros foliosa* Wall. (Ebenaceae), *Buchanania lanceolata* Wight, *Semecarpus auriculata* Bedd. (Anacardiaceae), *Helicia nilagirica* Bedd. (Proteaceae) and *Ficus beddomei* King (Moraceae) so far known from Kerala or Tamil Nadu only are now known to extend further north.

The following species earlier known from adjacent North Kanara are now known from Shimoga district as well.

Hugonia belli Sedgw. (Malpighiaceae), *Eugenia macrosepala* Duthie (Myrtaceae), *Aglaia talbotii* Sundararaghavan = *A. littoralis* Talb. (Meliaceae), *Centratherum ritchiei* Hook. f., *Senecio belgaumensis* (Wight) C. B. Cl., *Vernonia ornata* Talb. (Asteraceae), *Croton gibsonianus* Nimmo, *Phyllanthus talbotii*. Sedgw. (Euphorbiaceae), *Globba canarensis* Baker (Zingiberaceae) and *Trias stocksii* Benth. ex Hook. f. (Orchidaceae).

In addition some plants like *Polygala arillata* Ham., *Tephrosia pulcherrima* (Baker) Gamble, *Meliosma pinnata* (Roxb.) Walp. sub. sp. *arnottiana* (Wight) Beuse Kom. *Rubus ellipticus* Sm., *Pleocaulis ritchiei* (C. B. Cl.) Bremek., *Anaphalis marcescens* C. B. Cl., *Dendrobium nutans* Lindl., *Fimbristylis kingii* C. B. Cl., *Isachne gracilis* Hubb., *Euphorbia lacta-* Roth etc., which normally occur at 1000 m or above, have been collected from Shimoga district at a much lower altitude. Four species, namely *Capparis cleghornii* Dunn (Rolla Rao & R. Sundararaghavan, 1964), *Chilocarpus malabaricus* Bedd., *Aglaia talbotii* Sundararaghavan (Sundararaghavan 1964; 1969), and *Centratherum mayurii* C. E. C. Fischer have been re-collected after a long lapse of time. The studies have also contributed to a better understanding of the genus *Mastixia* Bl., represented by only *M. arborea* (Wight) Bedd., in Peninsular India. *M. meziana* Wang., is only an ecological variant of *M. arborea* (Sundararaghavan 1978).

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